# SECTION 02640 - FIBERGLASS REINFORCED POLYESTER MORTAR PIPE

## City of San Diego, CWP Guidelines

## PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing centrifugally cast fiberglass-reinforced polyester mortar-type pipe, complete, for carrier pipe grouted inside a primary-lined tunnel.

1.2 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC), as specified in Section 01090 - REFERENCE STANDARDS.

1.3 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, also apply to the extent required for proper performance of this WORK.

1. Section 02140 Dewatering
2. Section 02200 Earthwork
3. Section 02340 Boring and Jacking
4. Section 02730 Sanitary Sewerage System Testing

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

| | |
|---|---|
| ASTM D 2412 | Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading |
| ASTM D 3262 | "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Sewer Pipe |
| ASTM D 3681 | Standard Test Method for Chemical Resistance of Reinforced Thermosetting Resin Pipe in a Deflected Condition |
| ASTM D 4161 | "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Pipe Joints Using Elastomeric Seals |
| ASTM F 477 | Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Product data, including details and size, thickness, and length of pipe, joints, gasket, and grout bushings.

2. Material properties and strength of pipe and gaskets.

3. Manufacturer's certification that the proposed piping system, including internal resin liner and gasket material are appropriate for the intended service.

4. Pipe Design Analysis: If computer calculations are used, include example calculations to show the logic employed.

5. Manufacturer's written instructions for handling, transporting, storage, and installation of pipe.

6. Test Reports: Submit reports from tests in accordance with ASTM D 3262, ASTM D 3681, and ASTM D 4161.

[7. Pipeline layout and profile drawings showing location, station , and invert elevation of pipe sections, fittings, closure pieces, and test closures.]

8. CONTRACTOR's plan for the grouting operation, including:

a. Description and drawing showing locations of mixing and injection equipment, injection points, flowlines, waste grout recovery, and grout pressure limiting equipment.

b. Description of grout system and equipment, including pumps, mixers, delivery systems, and monitoring systems.

c. Number and spacing of grout holes including simultaneous hole use and return flow and inspection holes.

d. Procedure for monitoring grout placement and pressure control.

e. Sequence of construction and grout time schedule.

9. CONTRACTOR's proposed grout

a. Grout mix design including fluidizers, accelerators, and other additives.

b. Grout density, viscosity, bleeding, shrinkage, expansion, and set time.

c. Mixing and installation instructions from grout manufacturer, including data on water volume, workability, and temperatures.

d. Seven and 28 day results from three replicate tests of compressive strength of the proposed grout mix.

1.6 FACTORY INSPECTION AND TESTING

A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for [two] OWNER-designated inspectors for [ ] days required to complete such inspections or observations exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400.

B. All pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing start date not less than 14 days prior to start of manufacture.

C. **Testing:** Manufacturer shall furnish results from qualification tests of:

1. Pipe of the same dimensions and composition, in accordance with ASTM D 3262.

2. Joints of the same size and type, in accordance with ASTM D 4161.

1.7 FIELD TESTING

A. Field Testing shall conform to the requirements of Section 02730.

## PART 2 PRODUCTS

2.1 MATERIALS

A. Resin Systems: The manufacturer shall use only polyester resin systems with a proven history of satisfactory performance in the intended application for this project. The historical data shall be collected from applications of a composite material of similar construction and composition as the proposed pipe.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the pipe and fittings shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.

C. Fillers: Sand shall be minimum 98 percent silica, kiln dried and graded.

D. Additives: Resin additives, such as pigments, dyes, and other coloring agents, if used, shall in no way be detrimental to the performance of the product nor impair visual inspection of the finished products.

E. Rubber Gaskets: Gaskets shall be in accordance with ASTM F 477 and be suitable for the service intended. Gaskets shall either be affixed to the pipe by means of a suitable adhesive or shall be installed in such a manner so as to prevent the gasket from rolling out of the precut groove.

F. The internal liner resin shall be suitable for sewer pipe service and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases. Pipe shall meet or exceed requirements of ASTM D 3681.

2.2 PRODUCTS

A. Pipe and Fittings

1. Pipe and fittings shall conform to ASTM D 3262 for gravity service, and shall be manufactured by a centrifugal casting process.

2. Diameters: Unless indicated otherwise, the nominal size and actual outside diameter of the pipes shall be in accordance with Table 3 of ASTM D 3262.

3. Lengths: The pipe standard length shall be approximately 20 feet. A maximum of 10 percent of the lengths, excluding special order pipes and pipes sampled for quality control testing, may be supplied in random lengths.

4. Wall Thickness: The minimum wall thickness shall be the greater of (1) the indicated thickness, or (2) the thickness required to satisfy the maximum allowable jacking load as recommended by the pipe manufacturer. Minimum safety factor shall be 2.5. The minimum thickness at any single point shall not be less than 90 percent of the indicated minimum thickness. Walls shall not have stiffening ribs or rings.

5. End Squareness: Pipe ends shall be square to the pipe axis.

6. Stiffness class of gravity pipe shall satisfy design requirements, but shall not be less than 36 psi when tested in accordance with ASTM D 2412. Stiffness class in a jacking operation shall be as required by jacking methods and shall satisfy design requirements.

7. Grout bushings shall be installed at the factory.

B. Joints: Joints shall be sleeve couplings meeting the requirements of ASTM D 4161 and as appropriate for jacking operations. Elastomeric gaskets shall be the sole means of achieving watertightness.

C. Grout

1. Cement shall be standard portland cement conforming to ASTM C 150 for Type II or Type V. Type II cement shall meet the false set penetration requirements of Table 4 of ASTM C 150.

2. Sand: Conform to ASTM C 144 except as modified below.

a. Fineness modulus: Between 1.50 and 2.00.

b. Gradation Requirements:

| Sieve Size | Percentage Passing by Weight |
|---|---|
| No. 8 | 100 |
| No. 16 | 95 - 100 |
| No. 30 | 60 - 85 |
| No. 50 | 20 - 50 |
| No. 100 | 10 - 30 |
| No. 200 | 0 - 5 |

3. Gravel: Gravel shall be clean, rounded aggregate graded from 1/4 to 3/8 inch size, non-reactive, and shall conform to ASTM C 33.

4. Water shall be potable, clean and free from silty organic matter, alkali, chlorides, and other impurities.

5. Grout Compressive Strength: Minimum strength of 100 psi in 24 hours.

6. Fluidifier:

a. Shall hold the solid constituents of the grout in colloidal suspension and be compatible with the cement, sand, gravel, and water used in the grout.

b. Shall contain an expansive shrinkage compensator. Fluidifier shall not contain bentonite or other clay-like substances.

c. Approved Fluidifiers: Calcium ligno-sulfonate and sodium ligno-sulfonate.

d. Storage: Fluidifier shall be furnished in sealed containers and shall be protected from moisture at all times. Material which has become caked due to moisture absorption shall be rejected.

7. Admixtures: Other admixtures may be used subject to the approval of the CONSTRUCTION MANAGER to improve the pumpability, control set time, to hold sand in suspension, and to prevent segregation and bleeding. Admixtures that promote steel corrosion shall not be permitted.

D. Spacers shall be as indicated in Section 02340.

2.3 PIPE MANUFACTURER, or Equal

A. **Hobas Pipe USA, Inc.**

## PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Handling and Storage: All pipe handling and storage shall be strictly in accordance with the pipe manufacturer's recommendations.

3.2 INSTALLATION OF PIPE

A. **Transport to Position:** Pipe shall be transported from storage to position in the jacking pit according to the pipe manufacturer's recommendations to avoid damage.

B. Pipe shall be placed on guides with spigot end first.

C. Jacking forces shall be applied evenly to the pipe wall end, not the integral straight bell or sleeve. Pushing forces shall not exceed the manufacturer's recommendations with a jacking load safety

factor of 2.5.

D. Spacers and runners shall be installed around the pipe in accordance with the manufacturer's recommendations to provide uniform clearance between the pipe and the tunnel primary liner.

E. Any pipe damage during handling and storage or by transport or jacking operations shall be repaired according to the manufacturer's recommendation or removed from the site and replaced at the CONSTRUCTION MANAGER's option, at no additional cost to the OWNER. The CONSTRUCTION MANAGER's decision regarding rejection shall be final. Rejected pipe shall be clearly and indelibly marked to prevent confusion with pipe in subsequent shipments.

3.3 GROUTING

A. The annular space between the pipe and the tunnel primary liner shall be backfilled by forcing mixed grout through the grout bushings in a continuous flow until a predetermined pressure is reached. Verify that grout fills all voids by observing return flow from relief and grout holes.

B. Pumps shall be capable of continuously developing a uniform pressure at the grout bushing adequate to completely fill the annular space between the primary tunnel support and the pipe with grout.

C. Grouting equipment shall continuously circulate grout and control pressure accurately. Equipment and lines shall be kept clean by continuous circulation of grout and by periodic flushing with water.

D. The mixer shall be provided with a meter for measuring the amount of mixing water used. The meter shall be calibrated to read in cubic feet to the nearest one-tenth of a cubic foot.

E. In addition to the grout mixer, mechanical agitator tanks equipped with suitable screens shall be used.

F. Two pressure gauges shall be in working order at all times, one at the grout pump and one at the manifold hookup at the collar of each hole being grouted. The accuracy of the gauges shall be periodically checked with a calibrated high- accuracy pressure gauge. A spare gauge shall be available on site at all times.

G. Equipment and grouting procedures shall be such that grouting pressures at the grout hole connection in excess of 12 psi shall not occur. Suitable stop valves shall be provided at the collar of each hole for use in maintaining pressure as required until the grout has set.

H. The grouting equipment shall be provided with a meter to determine the volume of grout injected. The meter shall be calibrated in cubic feet to the nearest one-tenth of a cubic foot.

I. The grouting equipment shall be maintained in satisfactory operating condition throughout the course of the work to ensure continuous and efficient performance during grouting operations.

J. Hoses for grouting operations shall have an inside diameter not less than 1½ inches nor greater than 2 inches and shall be capable of withstanding the maximum pressures to be used.

K. Grouting shall progress from grout hole to grout hole on both sides of the pipe, starting at the lowest holes with the upper holes left open and proceeding upward. Grouting at any location shall be continued to completion once started.

L. In general, grouting will be considered completed when less than one cubic foot of grout of the accepted mix and consistency can be pumped for a period of 5 minutes under the indicated maximum pressure.

M. After the grout injection is finished, the pressure shall be maintained by means of a stop cock or other suitable device until the grout has set to the extent that it will be retained in the hole.

N. PVC plugs shall be inserted into the grout bushings, flush with the inner surface of the pipe.

- END OF SECTION -